空间导航能力性别差异的三水平元分析*

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摘要　空间导航是不可或缺的基本认知能力，尽管已有大量研究探讨其性别差异，但关于差异的存在和大小尚无定论。本研究对 173 项研究(总样本量 *N*=26604)和 372 个独立效应量进行三水平元分析，结果表明，大多数条件下男性的空间导航能力强于女性，但性别差异受年龄、表征方式、时间限制、任务环境、测试场景、辅+助装备的调节，在婴幼儿期、成年晚期的人群中，以及室内－室外双重测试和无辅助设备条件下，空间导航能力的性别差异不显著。本研究明确了空间导航能力的性别差异及其调节因素，为教育实践中缩小性别差异提供了参考。

关键词　空间导航能力, 性别差异, 三水平元分析, 调节效应

收稿日期：2024-10-10

* 国家自然科学基金面上项目“空间能力的性别差异以及空间能力对数学能力的影响：基因-脑-行为的研究”(31871120)资助。

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1 引言

空间导航(Spatial Navigation)是个体在空间中更新自身位置与方向、学习新地点的布局以及在环境中规划并沿某一路线到达目的地的能力(Yu et al., 2021)。它涉及感知觉、情景记忆、决策等多种认知过程，可以帮助个体及时转移住处，以补充食物、水源等生存所必需的资源，保障自身安全(Hills et al., 2015)，并满足更高水平的行动需要(Moser & Moser, 2016)，因此是人与动物赖以生存的基本能力之一(Poulter et al., 2018)。性别是空间导航能力个体差异的重要来源。以往相当多的研究发现男性的空间导航能力优于女性(eg. Merrill et al., 2016; Nazareth et al., 2018; Yu et al., 2021; Zhou et al., 2020)，然而亦有一部分研究并未发现男女差异(eg. Learmonth et al., 2008; Liao & Dong, 2017; Vieites et al., 2020)，甚至还有研究发现女性的空间导航能力优于男性(eg. Bocchi et al., 2020)。在这些研究中，性别往往与研究设计等因素交互作用，共同影响空间导航能力。因此，有必要系统探究空间导航能力的性别差异，并寻找性别差异的潜在影响因素。

1.1 空间导航能力的性别差异

空间能力一直被认为是男女性在所有认知能力中差异最大的(Halpern, 2011)。虽然许多领域中的性别差异正逐渐消失或减少，但空间能力的性别差异始终存在(Hyde, 2005; Martens & Antonenko, 2012)。早年，Linn 和 Peterson(1985)报告男性与女性在空间任务上的差异效应量为 0.73，这一差异在过去几十年间并没有明显改变(Maeda & Yoon, 2013)，近二十年来的研究同样表明男性有更好的空间能力(eg., Lauer et al., 2019; Lee et al., 2019; Yuan et al., 2019)。基于解决空间问题时涉及的不同参考框架，空间能力可分为小尺度和大尺度两类(Yuan et al., 2019)，前者主要基于环境中心的表征，典型任务如心理旋转；后者主要基于自我中心的表征，典型任务如空间导航。

男性的小尺度空间能力比如心理旋转明显优于女性，这一结论已在相关研究中得到广泛支持，然而大尺度的空间导航能力是否存在显著的性别差异尚无定论。根据 Silverman 和 Eals(1992)的狩猎者－采集者理论，男女性在大尺度空间能力上存在性别差异，并且属于质的差异而非量的不同。这一差异的关键影响因素是人类祖先的原始分工，其中男性主要扮演狩猎者的角色，负责长途狩猎，女性则扮演采集者的角色，负责采集作物和资源，这两种空间活动的差异逐渐导致了男女性空间能力的差异。目前，该理论得到了不少研究的支持，这些研究基本发现男性比女性表现出更强的空间导航能力(eg., Boone et al., 2018; Munion et al., 2019; Yu et al., 2021)，但性别差异的程度不尽相同(eg., Coutrot et al., 2018; Munion et al.,

2019)。还有一些研究并未发现性别差异，如要求被试在包含多个地标的虚拟环境中进行导航(Andersen et al., 2012)，或通过指向任务测量个体的空间导航能力(Arnold et al., 2013; Hund & Padgitt, 2010; Labate et al., 2014; Marchette et al., 2011; Postma et al., 2012)。

1.2 空间导航能力性别差异的调节变量

空间导航能力的性别差异没有一致结论的现象背后，可能是某些因素调节了空间导航能力性别差异的大小。

(1)年龄。年龄与空间导航能力的性别差异具有紧密联系。大多数对空间导航能力性别差异起点的研究聚焦在 6 至 12 岁的学龄期，这一时期的儿童表现出明显的性别分化(Hemmer et al., 2013; León et al., 2014; Merrill et al., 2016)。根据 Nazareth 等(2018)的研究，12 岁是一个过渡年龄，此时青少年开始在大尺度的空间导航任务中表现出与成人相似的熟练程度，且男性表现出更好的空间导航能力。在步入青春期及长大成人后，男女性的空间导航能力依然表现出明显差异(Liu et al., 2011; Sneider et al., 2015; Yu et al., 2021)。对学前期儿童空间导航能力性别差异的研究相对较少，且结论并不一致。如 Sorrentino 等(2019)的研究发现 4 至 6 岁的男孩在完成搜索桶任务时搜索效率和完整度都优于女生。然而，在涉及几何线索和单一地标的空间定向测试中，3 至 6 岁的儿童未表现出性别差异(Learmonth et al., 2008; Vieites et al., 2020)。因此，年龄可能是影响空间导航能力性别差异的重要调节变量。

(2)地区。地区是影响空间导航能力的重要因素，不同地区的居民受社会文化等因素影响而可能偏好不同的导航策略，发展不同程度的空间导航能力(Goeke et al., 2015; Schug, 2016a)。尽管尚未有跨文化研究直接发现地区对空间导航能力性别差异的影响，但依据霍夫斯泰德的文化维度理论(Hofstede, 1984)，社会文化中的男性化与女性化、集体主义与个体主义等文化特征会共同塑造人们对性别角色的认知和行为期望，因而可能导致男女性空间导航能力的地域差异性。综述以往研究，大多数来自美国和欧洲的研究都发现了男性在空间导航能力上的显著优势，而许多其他地区的研究却未观察到这一差异。例如，来自中国的研究在使用指向任务、物体定位、距离估计任务测量空间导航能力时均未发现显著性别差异(赵梦雅, 肖承丽, 2019; Liao & Dong, 2017)，甚至在路径重走任务中发现女性空间导航能力表现优于男性(赵梦雅, 肖承丽, 2019)。来自土耳其(Memikoglu & Demirkan, 2020)和墨西哥的研究(Woolley et al., 2010)同样未发现空间导航能力的性别差异。因此本研究推测，地区可能是影响空间导航能力性别差异的潜在调节变量。

(3)研究设计特征。空间导航任务的研究设计和评估指标也可能成为性别差异的异质性来源。由于空间导航能力的测量任务和测量指标类别丰富，不同研究者可能使用不同任务(如

路线学习与重走任务、目标指向任务、虚拟水迷宫任务)和测量指标(如正确率、反应时、总距离、偏差程度)测量空间导航能力，这可能导致性别差异的大小甚至方向不同。例如，在二维矩阵导航任务中，女性的反应时更快，而在真实驾驶场景识别任务中，男性的准确率更高(Kim et al., 2007)；一项元分析也揭示了指向和回忆任务比距离估计任务所测得的性别差异更大(Nazareth et al., 2019)。男女性在空间导航过程中的表征方式也有所不同，当可以自由选择表征方式时，男性主要进行环境中心表征，综合使用环境线索和路标线索，而女性主要进行自我中心表征，偏好使用路标线索进行导航(Lavenex & Lavenex, 2010; Rosenthal et al., 2012)，这也可能导致性别差异。此外，空间导航任务设计中的测试场景、辅助装备、任务环境都可能成为影响空间导航能力性别差异的潜在因素。例如，同样是使用指向任务，虚拟环境中的指向任务大多具有稳定的性别差异(Castelli et al., 2008; Persson et al., 2013)，而真实环境中的指向任务结论不一(Labate et al., 2014; Marchette et al., 2011; Meneghetti et al., 2011)；与使用电子设备不同，许多使用纸笔作为辅助装备(Kastens et al., 2007; New et al., 2007)或不提供辅助装备(Bocchi et al., 2020; Piccardi et al., 2014)的研究并未发现性别差异；大多数室外研究都发现了显著的性别差异，而 Wang 等人(2018)的室内研究则并未发现男女性在自我定位、路线阅读和路线跟随方面的能力差异。

1.3 研究目标

综上所述，以往大量研究考察了空间导航能力的性别差异，但研究结论并不一致。因此，空间导航能力是否存在性别差异还有待澄清。如果存在差异，方向是怎样的，是否受被试特征、研究设计等因素影响？本研究的第一个目标是纳入以往有关空间导航能力与性别关系的研究，通过三水平元分析探究男女性在空间导航能力方面是否存在显著差异。基于以往多数研究，本研究推测：空间导航能力性别差异显著，总体而言，男性的空间导航能力强于女性。

本研究的第二个目标是分析调节因素对性别与空间导航能力关系的影响。基于以往研究结果，本研究推测：个体变量(年龄和地区)和任务变量(表征方式、时间限制、任务环境、测试场景、辅助装备、任务类型、测量指标)均能够调节空间导航能力与性别的关系。

2 方法

2.1 文献检索与筛选

文献检索：元分析中的所有文章通过搜索关键词进行检索。搜索关键词包括：spatial navigation, wayfinding, spatial orientation, cognitive map, spatial representation, spatial cognition,

spatial exploration, sense of direction。本研究通过多个数据库进行检索，以确保文献的全面性和系统性，所用中文数据库包括：中国知网(CNKI)、万方、维普，英文数据库包括：Web of Science、PubMed、EBSCO、PsyArXiv，并结合手动检索以补充遗漏的相关文献。检索过程如下：(1)通过检索关键词，查找文献并阅读摘要；(2)若摘要表明文献与本研究主题相关，则阅读文献全文；(3)若摘要表明文献与主题相关，但无法获取全文，则通过邮件向通讯作者寻求帮助。

筛选标准：(1)研究必须包含至少一种空间导航任务，排除自我报告或他人报告(调查)的结果；(2)必须同时收集男性和女性的数据；(3)必须报告所测量空间导航任务和性别的个数、平均数、标准差；(4)研究纳入被试的年龄在 0 至 85 岁之间；(5)文献语言为中文或英语；(6)不纳入回归分析、结构方程模型或其他数据分析方法得出的数据。最终得到符合要求的文献共 173 篇，其中中文文献 8 篇，外文文献 165 篇，筛选过程详见图 1(*n* 代表数量)。

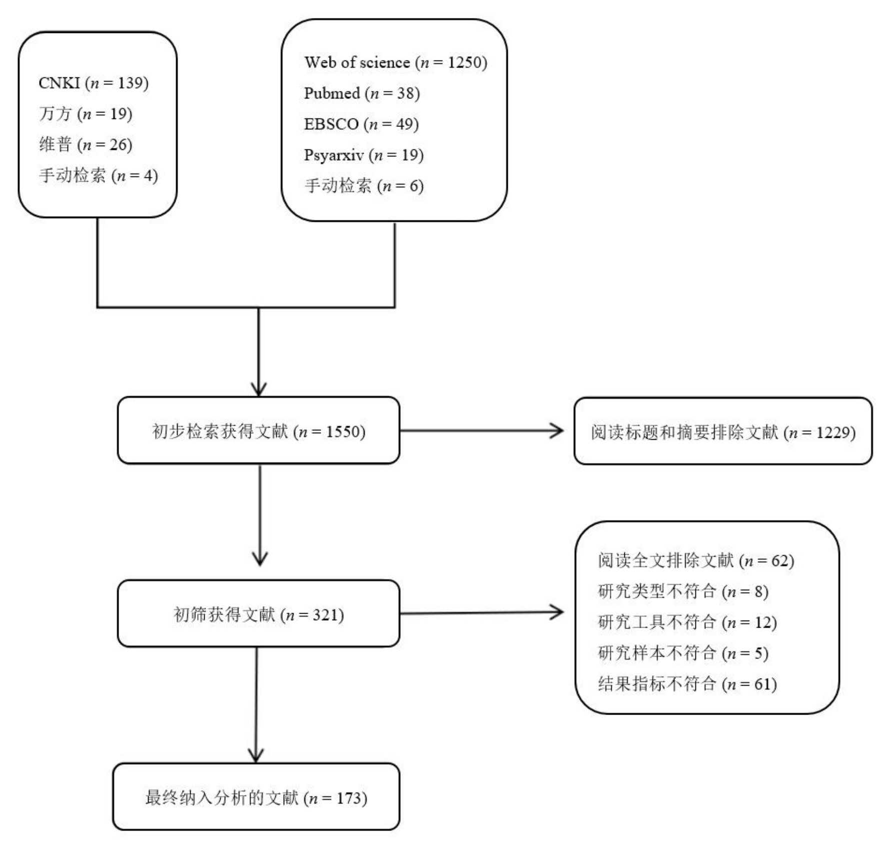


图 1　文献筛选流程

2.2　文献特征编码

根据 Lipsey 和 Wilson (2001)的方法对文献数据进行编码：(1)被试年龄(婴幼儿期 0 至 4 岁 vs. 儿童期 4 至 12 岁 vs. 青少年期 12 至 18 岁 vs. 成年早期 18 至 40 岁 vs. 成年中期 40 至 65 岁 vs. 成年晚期 65 岁以上 vs. 跨年龄)；(2)地区(亚洲 vs. 欧洲 vs. 大洋洲 vs. 北

美洲 vs. 南美洲 vs. 跨国)；(3)表征方式(自我中心 vs. 环境中心)；(4)时间限制(限时 vs. 不限时)；(5)任务环境(室内 vs. 室外 vs. 水迷宫 vs. 室内–室外)；(6)测试场景(真实场景 vs. 虚拟场景)；(7)辅助装备(电子设备 vs. 书写工具 vs. 无设备)；(8)任务类型(闭环 vs. 地图绘制 vs. 地图使用 vs. 路标再认记忆 vs. 路线描述 vs. 路线学习与重走 vs. 目标指向 vs. 虚拟水迷宫)；(9)测量指标(反应时 vs. 总距离 vs. 正确率 vs. 速度 vs. 偏差程度 vs. 效率)。

在编码过程中，主要遵循以下原则：(1)每一个独立样本编码为一个效应值，如果同时报告了多个独立样本，则分别编码；(2)若同一项研究对不同年龄段的被试分别报告其结果，则分别编码；(3)若研究为纵向研究，则对每次结果分别编码。编码由两位评分者独立完成，编码不一致时，由两位评分者重新阅读原始文献，并在共同讨论后统一结果。最终的编码一致性 k 值分别为：(1)被试年龄：$k = 1.00$；(2)地区：$k = 1.00$；(3)表征方式：$k = 0.94$；(4)时间限制：$k = 0.98$；(5)任务环境：$k = 0.98$；(6)测试场景：$k = 0.95$；(7)辅助装备：$k = 0.98$；(8)任务类型：$k = 0.98$；(9)测量指标：$k = 0.98$。

2.3 元分析过程

2.3.1 三水平元分析的效应量计算

本研究选取标准化均数差(standardized mean difference, SMD)Cohen’s d 作为效应量。由于空间导航能力的测量方法和指标种类颇多，许多文献包含多个效应量，导致效应量之间存在依赖性，与传统元分析方法认为效应量相互独立的假设不符，故采用三水平元分析方法，通过补充研究内方差来考虑效应量之间的依赖性(Cheung, 2014)，总方差来源被分解为抽样方差(水平 1)、研究内方差(水平 2)、研究间方差(水平 3)(Hox et al., 2017)。相较于传统方法，三水平元分析更适合复杂数据结构的处理，不仅解决了效应量不独立的问题，还在保留原始文献信息完整性的同时，有效提升了统计效率和稳健性(Cheung, 2019)。

2.3.2 数据处理与分析

采用 R x64 4.2.2-win 版本的 metafor 包进行三水平元分析(Viechtbauer, 2010)，参照 Assink 和 Wibbelink(2016)以及 Harrer 等人(2021)的教程编写 R 语法。首先参照 Cheung(2014)的方法对抽样方差(水平 1)进行估计，然后对研究内方差(水平 2)和研究间方差(水平 3)进行单侧对数似然比检验。若研究内方差和研究间方差显著，则进一步进行调节效应检验以确定异质性的来源(Gao et al., 2017)。

2.3.3 研究特征

当前元分析包括 173 项研究，共有 372 个独立效应量，26604 名被试。在同一项研究中，效应量数最少为 1，最多为 7，纳入文献的发表时间为 2007 年至 2023 年。

2.3.4 发表偏倚检验

漏斗图上代表效应量的点基本分布在平均效应量的两侧且位于顶端，但 Begg 检验(t = 0.07, p = 0.086)和 Egger 检验(t = 4.39, p < 0.001)都表明可能存在一定程度的发表偏倚。为进一步评估发表偏倚的影响，采用了 Duval 和 Tweedie(2000)的 Trim-and-Fill 方法，该方法估计可能存在 93 项缺失研究，补充这些研究后效应量略微降低(从 0.39 降至 0.23)，但调整后效应量仍显著(p < 0.001, 95% CI [0.18, 0.28])，即发表偏倚对空间导航能力与性别关系的总效应影响是有限的，元分析结果依然具有稳健性(见图 2)。

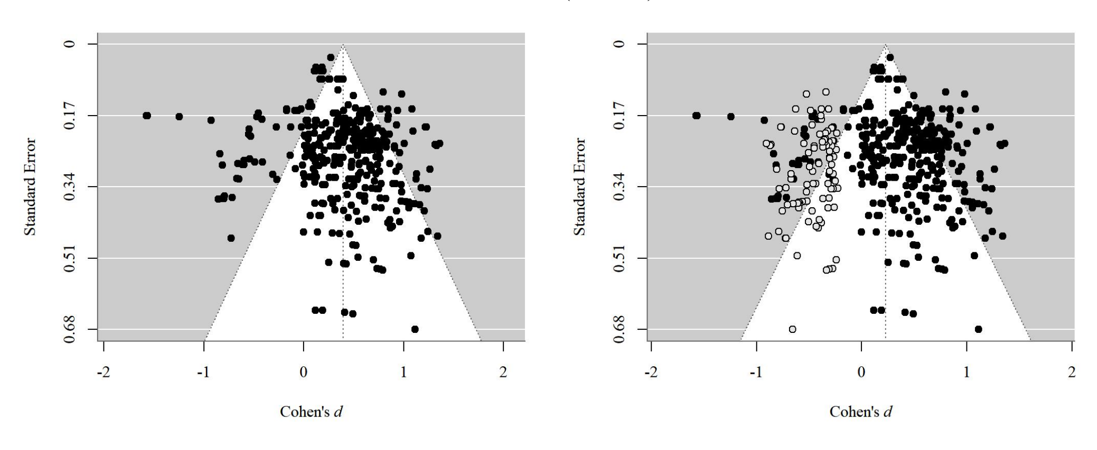


图 2　效应量 d 分布的漏斗图

注：图中 x 轴为 Cohen's d 效应量，y 轴为每个效应量对应的标准误。左图为原始漏斗图，表示未调整的效应量分布；右图为经过 Trim-and-Fill 方法调整后的漏斗图，其中空心点代表通过调整方法补充的潜在缺失研究。

3 结果

3.1 空间导航能力性别差异的主效应检验

随机效应模型假设，每个单独研究的效应量并非来源于完全相同的总体，而是围绕一个总体效应的分布，这意味着个体研究的效应量可能因种种差异(如被试特征、研究方法、测量工具、研究情境等)而有所不同，而随机效应模型允许这些差异作为系统变异的一部分进入模型。因此，本研究选择了随机效应模型进行主效应检验。

主效应检验结果表明，男女性空间导航能力存在显著差异(d = 0.39, p < 0.001, 95%CI [0.33, 0.46])，这一结论符合研究假设。此外，采用单侧对数似然比检验法确定研究内方差和研究间方差的显著性，结果表明，本研究的研究内方差(p < 0.001)和研究间方差(p < 0.001)均存在显著差异。在总方差来源中，抽样方差为 18.66%。研究内方差为 11.94%，研究间方差为 69.40%。每个独立样本的效应量及总体效应量的森林图见附录 1。因此，进行调节效

应检验，以确认男女性空间导航能力的差异来源。

3.2　空间导航能力性别差异的调节效应检验

空间导航能力性别差异的调节效应检验结果如表 1 所示。结果表明：(1)年龄具有显著的调节效应，$F(6, 361) = 2.91$，$p = 0.009$，在 4 至 65 岁的群体及跨年龄研究中，空间导航能力的性别差异显著存在，男性优势明显。在婴幼儿期(0 至 4 岁)和成年晚期(65 岁以上)，未发现显著的性别差异；(2)表征方式具有边缘显著的调节效应，$F(1, 370) = 3.44$，$p = 0.064$，与自我中心的表征方式相比，男女性被要求使用环境中心的表征方式时的空间导航能力差异更大；(3)时间限制具有边缘显著的调节效应：$F(1, 370) = 3.42$，$p = 0.065$，与不限时完成空间导航任务相比，男女性在有时间限制的空间导航任务中表现出更大的能力差异；(4)任务环境具有显著的调节效应，$F(3, 368) = 3.28$，$p = 0.022$，与室内测试相比，男女性在完成水迷宫任务时表现出更大的空间导航能力差异。而在室内－室外双重测试条件下，未发现性别差异；(5)测试场景具有显著的调节效应，$F(1, 370) = 9.74$，$p = 0.002$，与真实场景相比，男女性在视频场景中的空间导航能力差异更大；(6)辅助装备具有显著的调节效应，$F(2, 369) = 7.41$，$p < 0.001$，男女性在使用电子设备、纸笔工具时表现出性别差异，而不使用辅助设备时则无性别差异。与假设不一致的是，在以下变量中并没有发现显著的调节效应：(1)地区：$F(6, 365) = 0.53$，$p = 0.786$；(2)任务类型：$F(7, 364) = 1.17$，$p = 0.322$；(3)测量指标：$F(5, 366) = 1.92$，$p = 0.091$。

表 1　调节效应检验结果

调节变量	*k*	Intercept/mean *d* [95% CI]	*B* [95%CI]	*F* (df_1, df_2)	*p*	水平 2 方差	水平 3 方差
(1) 样本特征							
a. 年龄	368						
婴幼儿期(0 至 4 岁)	2	–0.83 [–1.73, 0.07]		$F(6, 361) = 2.91$	0.009**	0.02***	0.13***
儿童期(4 至 12 岁)	39	0.43 [0.24, 0.62]***	1.25 [0.01, 0.03]**				
青春期(12 至 18 岁)	2	0.59 [0.23, 1.41]**	1.42 [0.20, 3.63]*				
成年早期(18 至 40 岁)	243	0.43 [0.36, 0.51]***	1.26 [0.36, 2.16]**				
成年中期(40 至 65 岁)	9	0.68 [0.11, 1.25]*	1.51 [0.44, 2.57]**				
成年晚期(65 岁以上)	6	0.32 [–0.16, 0.80]	1.14 [0.12, 2.16]*				
跨年龄	67	0.22 [0.09, 0.36]***	1.05 [0.14, 1.96]*				

b. **地区**	372						
亚洲	44	0.35 [0.17, 0.53]***		F(6, 365) = 0.53	0.786	0.02***	0.14***
欧洲	146	0.39 [0.28, 0.49]***	0.03 [–0.18, 0.24]				
北美洲	156	0.40 [0.29, 0.50]***	0.04 [–0.17, 0.25]				
南美洲	2	0.69 [–0.17, 1.56]	0.34 [–0.55, 1.23]				
非洲	5	0.20 [–0.30, 0.69]	–0.16 [–0.68, 0.37]				
大洋洲	8	0.67 [0.27, 1.07]**	0.31 [–0.12, 0.75]				
跨国	11	0.43 [0.11, 0.76]**	0.08 [–0.29, 0.46]				
(2) **研究设计特征**							
a. **表征方式**	372						
自我中心	208	0.34 [0.26, 0.43]***		F(1, 370) = 3.44	0.064†	0.02***	0.13***
环境中心	164	0.43 [0.35, 0.51]***	0.09 [–0.18, 0.01]				
b. **时间限制**	372						
限时	173	0.44 [0.36, 0.53]***		F(1, 370) = 3.42	0.065†	0.02***	0.13***
不限时	199	0.35 [0.27, 0.43]***	–0.096 [–0.20, 0.01]				
c. **任务环境**	372						
室内	190	0.38 [0.30, 0.46]***		F(3, 368) = 3.28	0.022*	0.13***	0.08***
室外	146	0.35 [0.26, 0.44]***	–0.02 [–0.13, 0.08]				
水迷宫	34	0.66 [0.47, 0.86]***	0.29 [0.08, 0.50]**				
室内–室外	2	–0.06 [–0.73, 0.61]	–0.44 [–1.11, 0.23]				
d. **测试场景**	372						
真实场景	101	0.25 [0.14, 0.36]***		F(1, 370) = 9.74	0.002**	0.02***	0.13***
视频场景	271	0.45 [0.37, 0.52]***	0.20 [0.07, 0.33]**				
e. **辅助装备**	372						
电子设备	277	0.45 [0.38, 0.52]***		F(2, 369) = 7.41	0.000***	0.02***	0.13***
纸笔工具	50	0.37 [0.22, 0.51]***	–0.08 [–0.23, 0.07]				
无设备	45	0.13 [–0.02, 0.28]	–0.32 [–0.48, –0.15]***				
(3) **评估特征**							
a. **任务类型**							

闭环任务	2	0.07 [–0.43, 0.57]		F(7, 364) = 1.17	0.32	0.02	0.14
地图绘制任务	13	0.31 [0.09, 0.53]**	0.24 [–0.30, 0.78]				
地图使用任务	9	0.32 [0.06, 0.59]*	0.25 [–0.31, 0.81]				
路标再认记忆任务	34	0.31 [0.18, 0.43]***	0.24 [–0.27, 0.74]				
路线描述任务	8	0.41 [0.14, 0.67]**	0.34 [–0.22, 0.90]				
路线学习与重走任务	150	0.38 [0.29, 0.46]***	0.30 [–0.19, 0.80]				
目标指向任务	114	0.38 [0.29, 0.48]***	0.31 [–0.19, 0.82]				
虚拟水迷宫任务	42	0.58 [0.40, 0.76]***	0.51 [–0.02, 1.03]				
b. **测量指标**	372						
反应时	85	0.47 [0.37, 0.57]***		F(5, 366) = 1.92	0.09	0.02***	0.14***
总距离	38	0.29 [0.16, 0.41]***	–0.19 [–0.32, -0.05]**				
正确率	139	0.39 [0.30, 0.47]***	–0.09 [–0.20, 0.03]				
速度	16	0.48 [0.27, 0.70]***	0.01 [–0.22, 0.23]				
偏差程度	78	0.35 [0.24, 0.46]***	–0.12 [–0.25, 0.01]				
效率	16	0.31 [0.09, 0.52]**	–0.17 [–0.40, 0.06]				

注：*代表 $p < 0.05$，**代表 $p < 0.01$，***代表 $p < 0.001$，下同。

3.3 调节变量的多重回归分析

为排除调节变量之间的共线性，根据 Assink 和 Wibbelink(2016)的方法，对显著的调节变量进行多重回归分析。以年龄(婴幼儿期，0 至 4 岁)、任务环境(室内)、表征方式(环境中心)、时间限制(不限时)、测试场景(真实场景)、辅助装备(电子设备)为参照变量，结果显示至少有一个调节变量的回归系数显著偏离零(见表 2)，表明这些变量在控制其他调节变量的共线性影响后，对结果变量产生了独立的显著影响，进一步验证了其在空间导航能力中的独立调节作用。

表 2　调节变量的多重回归分析

调节变量		***k***	***B* [95%CI]**
	Intercept		–0.57 [–1.46, 0.33]
年龄	儿童期(4 至 12 岁)	39	1.10 [0.20, 1.99]*
	青春期(12 至 18 岁)	2	1.20 [0.02, 2.38]*
	成年早期(18 至 40 岁)	243	1.07 [0.19, 1.96]*

	成年中期(40 至 65 岁)	9	1.12 [0.08, 2.16]*
	成年晚期(65 岁以上)	6	1.05 [0.07, 2.03]*
	跨年龄	67	0.81 [–0.07, 1.70]
任务环境	室外	146	0.01 [–0.09, 0.12]
	水迷宫	34	0.23 [0.01, 0.44]*
	室内–室外	2	–0.37 [–1.06, 0.31]
表征方式	环境中心	164	–0.10 [–0.19, 0.00]
时间限制	不限时	199	–0.07 [–0.17, 0.03]
测试场景	视频场景	271	0.03 [–0.18, 0.25]
辅助装备	纸笔工具	50	–0.02 [–0.23, 0.19]
	无设备	45	–0.26 [–0.51, –0.01]*

多重回归模型	k = 368	F(14, 353) = 3.42	p < 0.001	水平 2 方差 0.02***	水平 3 方差 0.11***

4 讨论

本研究采用三水平元分析的方法，整合了 2007 年至 2023 年间的 173 篇有关空间导航能力的原始文献，以探究空间导航能力是否存在性别差异，并进一步考察哪些变量调节了空间导航能力与性别的关系。总体而言，空间导航能力存在性别差异，男性的空间导航能力更强。然而在婴幼儿期(0 至 4 岁)和成年晚期(65 岁以上)的人群中，未发现显著的性别差异；在室内－室外双重测试条件和个体不使用任何辅助设备参与测试的条件下，也未观察到性别差异。

4.1 空间导航能力的性别差异

本研究结果首先证实了空间导航能力存在性别差异，男性的空间导航能力优于女性，这一现象在 4 至 65 岁个体中普遍存在，且在大多数测试条件下具有显著体现。该结论与 Nazareth 等人(2019)的结论一致，可能与心理、生物、社会文化三方面的影响有关。

以往研究发现了多个心理因素对空间导航能力性别差异的潜在影响。空间焦虑是空间导航过程中常见的消极情绪，会负向预测个体的空间导航能力(van der Ham et al., 2020)，且在女性中更为常见(Huang & Voyer, 2017)。女性在时间限制条件下，可能产生更高的空间焦虑，这种负性情绪分散了认知资源，降低了对环境信息的加工能力(Nori et al., 2009; Voyer, 2011)，因此空间导航表现受阻。此外，Zeng 等人的研究(2012)发现，男女性的移动策略存在差异，

男性更看重速度而非移动的准确性，而女性更为谨慎，会通过牺牲速度来保证准确性，这种决策也会影响男女性的空间导航表现。

进化和生物学的视角也可以解释空间导航能力的性别差异。早期研究聚焦于验证狩猎者—采集者理论，发现当身处于森林时，男性能够以更短的路线回到出发点(Moffat et al., 1998)，这一过程涉及路线学习、路径整合、方位判断等能力，均有助于男性用长矛射中猎物，并尽快将捕获的猎物带回部落；而女性则比男性具有更大的空间视野(Burg, 1968)、更快的空间感知速度(Kimura, 1999)和更强的物品定位记忆(Silverman et al., 2007)，这可能源于采集任务中的进化适应。上述结论说明了进化过程中的两性劳动分工可能对男女性的空间导航能力具有不同影响。神经生物学的研究则基于男女性大脑结构和功能差异进行了解释。海马-内嗅皮层导航系统是核心的导航环路(王琳, 王亮, 2017)，其神经元能够通过相位进动(phase precession)表征空间位置，并参与非空间任务的信息编码，其中海马的位置细胞会在个体处于特定位置时激活，以形成环境的认知地图(Marchette et al., 2011)，内嗅皮层的网格细胞和头方向细胞分别提供空间距离度量和方向信息(Hafting et al., 2005; Long et al., 2022, 2024)。而在 Long 和 Zhang(2021)在躯体感觉皮层中发现的新导航系统中，神经元的功能与经典系统类似。这些系统的结构和功能差异为解释男女性空间导航的认知神经差异提供了基础，例如男女性在完成空间导航任务时均使用大面积脑区，但男性更多依赖海马体(Grön et al., 2000; Kong et al., 2017)；男性在环境中心导航中激活更多的顶叶和前额叶，而女性在自我中心导航中后部脑区激活更强(Noachtar et al., 2022)。睾酮素也可能影响空间导航能力的性别差异，有研究发现女性内源性睾酮水平与空间导航能力显著正相关，而这一相关性在男性中并不显著(Burkitt et al., 2007)；如果向女性注射睾酮素，则女性的内侧颞叶活性得到增强，空间导航表现有所提升(Pintzka et al., 2016)。目前对人类空间导航能力的神经生物学研究仍处于探索阶段，未来研究有必要结合神经成像技术，深入探讨不同空间导航系统在男女性中的功能差异，从而加深对大脑如何通过多种并行系统应对复杂导航任务的理解，为考察性别差异提供新的视角。

社会文化对男女性空间导航能力的影响也不可忽视。根据社会认知理论(Bussey & Bandura, 1999)，个体性别行为的发展不仅受进化生物学影响，还受到环境创新的塑造，会通过观察、经验和信息获取，形成对性别行为后果的认知，并在自我调节系统的作用下进一步影响性别行为。例如，“男主外，女主内”的刻板印象是人类社会中根深蒂固的观念之一，强化了社会文化对性别角色的期待(Ellemers, 2018)。这一观念与“男性空间导航能力优于女性”的刻板印象相互关联，“男主外”赋予男性更强的外部探索与导航角色，从而巩固了对

男性在空间任务中表现更优的期待，“女主内”则限制了女性对空间导航能力的认知与实践。这种性别刻板印象通过个体与社会文化的互动被内化，影响了男女性的自我调节系统和空间导航能力的发展。此外，一些传统的空间能力测试设计可能在无意间放大性别差异，强化了被试对性别空间刻板印象的认同，形成教育和社会互动中不断被重复和强化的恶性循环(Bartlett & Camba, 2023)。长此以往，即使男女性最初在空间导航能力上不存在差异，也会在社会文化潜移默化的影响下产生差异。有趣的是，Hults 等人(2024)综述了多项研究，指出在那些不存在“男主外，女主内”分工模式的狩猎采集文化中，当男性和女性从事类似的空间任务时，性别差异几乎消失(Jang et al., 2019; Trumble et al., 2016)，印证了上述观点，即空间导航能力的性别差异并非普遍存在，而是高度依赖于社会文化背景。

4.2 空间导航能力性别差异的调节因素

本研究通过三水平元分析对空间导航能力的性别差异进行了调节效应检验，以检验被试个体因素和研究设计因素是否会影响空间导航能力的性别差异。结果表明，年龄、表征方式、时间限制、任务环境、测试场景和辅助装备均发挥调节作用，而地区、任务类型、测量指标则不具有调节作用。

年龄是影响空间导航性别差异的重要因素。元分析结果表明婴幼儿期(0 至 4 岁)和成年晚期(65 岁以上)个体的空间导航能力不存在性别差异，而 4 至 65 岁的个体存在空间导航能力的性别差异。4 岁前儿童的空间导航能力尚处于初步发展阶段，受性别的社会化影响有限，而在进入幼儿期后，社会文化开始对性别角色的塑造产生更大影响。书籍、媒体和日常生活中存在诸多性别刻板印象，如 Berry 和 Wilkins(2017)发现在 1930 至 2017 年出版的 103 本儿童书籍中，男性角色占据主导地位，且常被描绘为具有领导力、勇敢和冒险精神的，这些特质往往与空间导航所需的寻路、定向等能力紧密相连。相反，很多女性角色被刻画为情绪化或表现出不安全感，可能会削弱女孩们对空间导航活动的兴趣、主动探索性和对空间导航能力的自我认知，进而导致男女性空间导航能力的发展开始分化。而当个体步入成年晚期时，男女性的空间导航能力均会大幅下降(Coutrot et al., 2022)，表现出低速度和低准确性(Merhav & Wolbers, 2019; Taillade et al., 2016; Zhong & Moffat, 2016)，这种能力的全面下降可能缩小甚至消除了性别差异，因此聚焦成年晚期的研究往往未能观测到空间导航能力的性别差异。

表征方式能够调节空间导航能力的性别差异，相较于环境中心的表征方式，个体在使用自我中心的表征方式时性别差异缩小。这一结论与假设及以往研究结论一致，即男性的环境中心表征能力强于女性(Hund & Minarik, 2006; Munion et al., 2019)，在使用环境中心的表征方式进行空间导航时更具优势。具体而言，男性在学习空间环境时倾向于关注整体、分析地

理分布、记忆物体间关系(Lithfous et al., 2013)，女性则更依赖局部环境信息，注重主客体间的关系(Coluccia, 2007)。而当要求被试使用自我中心的表征方式进行空间导航时，男性环境中心表征的优势被抑制，因而和女性的导航表现差距缩小。

时间限制是空间导航能力性别差异的调节因素，在不限制时间的条件下，男女性的性别差异缩小，这可能与女性在空间导航过程普遍较高的焦虑感有关(Lyons et al., 2018)，时间压力会加剧女性的焦虑，从而影响方向感和寻路表现(Kremmyda et al., 2016; Mendez-Lopez et al., 2020)，而没有时间限制则有助于缓解压力，促进她们的空间导航表现。

任务环境、测试场景、辅助装备均能够调节性别与空间导航能力的关系。研究结果发现，性别差异在室外环境中最大，在室内－室外双重测试条件下不显著；真实场景的性别差异小于视频场景；使用电子设备时性别差异最大，不使用任何辅助装备时则无显著性别差异。综上可知，男女性在完成具有更高生态学效度的空间导航任务时表现更为接近，与以往观点一致(Min & Ha, 2020)，这可能是由于男性的电子游戏经验更丰富，对电子设备的使用更熟悉。此外，男性在具有有限线索的环境中更具有优势，而在含有丰富近端线索的导航任务中性别差异不再显著(Barkley & Gabriel, 2007)。将空间导航测试设置在室外环境、真实场景能够给个体提供丰富的感官信息和环境线索，使个体能够更全面地感知和理解空间关系，这削弱了男性的空间导航优势，使女性更自然地运用空间导航能力，因此性别差异减小；而当在室内环境、视频场景进行导航能力测试时，男性的优势则使他们具有更好的表现。上述结论提示研究者在任务设计时重视环境真实性可能带来的影响。近年来日益普及的虚拟现实技术(VR)为评估人类空间导航提供了新工具。VR 环境可以操纵实验条件，控制无关变量，被试的学习机制也与真实环境中无异(Weisberg et al., 2014)，已被证实所测空间导航可以预测真实环境的空间导航(Santos et al., 2008)，且两者具有良好的可复制性(Lloyd et al., 2009)。未来研究可逐渐将桌面空间导航任务转向 VR 室外导航，模拟真实生活中的导航体验的真实感受，提升研究的生态学效度。

地区未影响男女性的空间导航能力，来自各个大洲的被试均在空间导航任务中表现出了显著的男性优势。一方面，可能是由于以往研究主要聚焦于亚洲、欧洲、北美洲，对南美洲、大洋洲、非洲缺乏关注，尤其是对贫困地区的研究不足，导致被试来源分布不均。另一方面，经济条件和生活环境作为更微观的因素，可能通过提供资源和挑战来调节男女性的空间导航能力差异。研究表明，空间导航能力与国家 GDP 和教育水平正相关(Coutrot et al., 2018)。在资源丰富的地区，男女均有更多接触科技与教育的机会，而在贫困地区，女性因性别角色限制在资源获取和能力发展上受阻(Amoo et al., 2019; McKinney et al., 2017)。此外，空间环境

能够驱动空间能力的发展(Pruden et al., 2011, 2020)，因此可能影响空间导航能力。Coutrot 等(2022)的全球研究印证了这一点，发现成长于复杂环境(如乡村)的人群导航能力优于城市居民，尤其在现代化国家更为明显，可能源于乡村的非规则地形和复杂布局提供了更多空间挑战，而城市的网格化结构减少了寻路机会。男女性在成长过程中的活动空间也往往不同，男性更有可能被家长允许外出游戏，且更倾向于开展具有探索性的活动，因此在童年期具有更高的外出频次、更远的出行距离和探索广度，积累了更多空间线索(Schug, 2016a, 2016b)，而女性接触复杂空间环境的机会较少。Uttal 等人(2013)的研究证实了当女性获得与男性相同的探索机会时，其空间定向能力可与男性持平。这些证据均表明，生活环境和经济条件可能通过与性别相互作用，影响空间导航能力的性别差异。未来研究应进一步聚焦这些因素，探索如何通过干预措施缩小差异。

空间导航能力的性别差异在不同任务类型和测量指标下均保持稳定，表明其评估的可靠性。然而，实际生活中的空间环境线索纷繁复杂，远非实验室环境中简化的任务所能完全涵盖，提示未来需探索更贴近现实的评估方法。近年来，VR 和移动设备等新兴技术为导航能力评估带来了革新，VR 可提供高沉浸感和逼真度的测试环境，移动设备则通过实时捕捉地理信息与空间布局，实现个性化和动态评估(Coutrot et al., 2022; Dong et al., 2022)。这些技术有效缩小了实验室与现实生活的差距，有助于在更真实的条件下测量空间导航能力。

4.3 研究意义、局限性与未来展望

本研究通过三水平元分析探讨了空间导航能力的性别差异及调节因素，澄清了目前关于空间导航能力是否存在性别差异的争议，确认了空间导航能力的男性优势现象，并识别了影响性别差异的调节变量。这为未来研究提供了重要启示，即应纳入更多具有代表性的人群，并选取更加贴近真实环境的测量方式，以深入揭示空间导航能力与性别的关系。在实践层面，空间导航能力是个体应对现实生活复杂任务和职业发展的重要技能，对促进男女在 STEM 领域的平等参与具有积极意义。教育工作者应注重培养学生的空间导航能力，尤其是通过针对性教学和实践活动，提升女性应对导航任务的信心和能力。这不仅有助于缩小性别差异，还能增强学生在真实环境中解决空间问题的能力，推动教育公平与社会发展。

本研究也存在一定的不足。首先，本研究所纳入的文献虽然包含中文和英文发表的文章，但是由数据来源所带来的语言偏差和文化代表性问题仍然存在，影响了地区变量调节作用的分析及社会文化对空间导航能力影响的理解。未来研究应纳入更多语言的文献，以涵盖更广泛的文化群体，提升研究的多样性与普适性。其次，本研究使用了多种检验评估发表偏倚，并使用 Trim-and-Fill 法减少偏倚的影响，尽管调整后效应量的显著表明研究结论具有稳健性，

但发表偏倚仍可能影响效应量估计。未来研究有必要纳入未发表或难以获得的数据，以进一步降低偏倚的影响。最后，由于空间导航性别差异领域的研究关注的群体具有较大异质性，测量工具多样，在亚组分析时个别亚组之间效应值个数差异较大，可能影响结果的准确性和普遍性。未来可通过纳入更多文献，尤其是关注个体生命早期的性别研究，验证亚组分析结果的稳健性，同时细化研究对象分类，提升亚组内的同质性，以提高结果的准确性和可靠性。

5 结论

本研究采用三水平元分析的方法，整合了 2007 年至 2023 年间的 173 篇有关空间导航能力的原始文献，结果证实了男性的空间导航能力优于女性。进一步发现：年龄对性别差异的调节作用显著，4 至 65 岁男性的空间导航能力优于女性，婴幼儿期和成年晚期的男女性空间导航能力无显著差异；研究设计中的表征方式、时间限制、任务环境、测试场景、辅助装备也能发挥调节作用，在自我中心的表征方式、不限时的任务条件、室内、真实场景、使用纸笔工具或不使用辅助装备时性别差异较小；地区、任务类型、测量指标等因素不发挥调节作用。

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A three-level meta-analysis of gender differences in spatial navigation ability

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Abstract: Spatial navigation is an essential cognitive ability, yet the existence and extent of gender differences in this domain remain contentious. A there-level meta-analysis was conducted, synthesizing data from 173 studies, with a total of 372 independent effect sizes and 26604 participants. The results indicated that spatial navigation ability generally exhibited gender differences, with males having stronger spatial navigation ability than females. However, these differences were influenced by various factors, including age, representation mode, time constraints, task environment, test scene, and auxiliary equipment. Specifically, gender differences in spatial navigation ability were not significant among infants and toddlers, in late adulthood, under dual indoor-outdoor testing conditions, or in the absence of auxiliary devices. These results provide a comprehensive analysis of gender differences in spatial navigation ability, identify key moderating variables, and offer evidence-based recommendations for educational practices aimed at reducing gender disparities in this domain.

Keywords: spatial navigation, gender differences, there-level meta-analysis, moderating effect

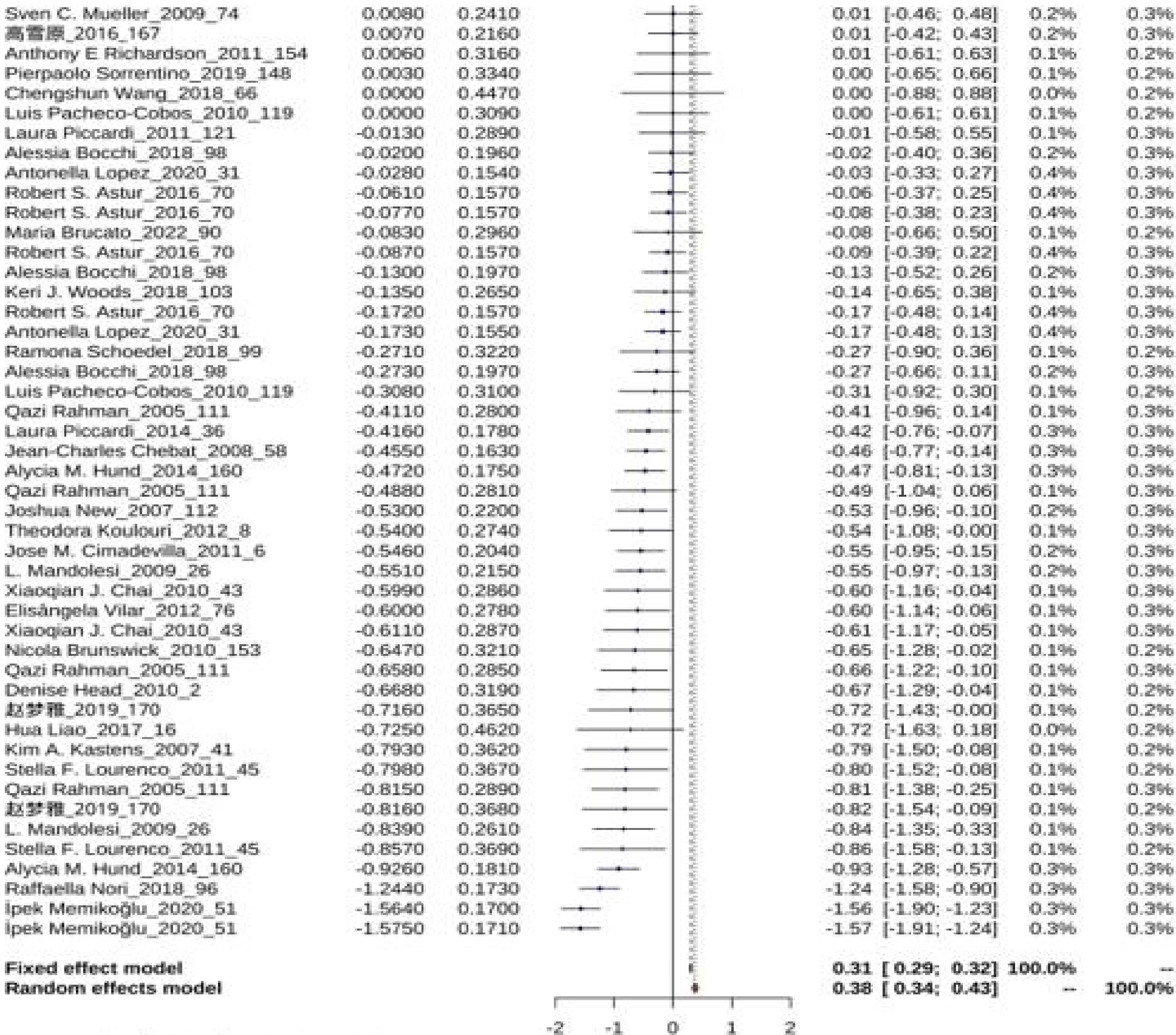
附录 森林图

Study	SMD	SE(SMD)	Standardised Mean Difference	SMD	95%-CI	Weight (fixed)	Weight (random)
Shuying Yu_2021_23	1.3620	0.2370		1.36	[0.90; 1.83]	0.2%	0.3%
Changxu Wu_2013_94	1.3410	0.4570		1.34	[0.45; 2.24]	0.0%	0.2%
Xiaoqian J. Chai_2009_117	1.3270	0.2410		1.33	[0.85; 1.80]	0.2%	0.3%
高雪原_2016_167	1.3160	0.2380		1.32	[0.85; 1.78]	0.2%	0.3%
Maddalena Boccia_2017_48	1.2630	0.2980		1.26	[0.68; 1.85]	0.1%	0.2%
Toru Ishikawa_2014_110	1.2440	0.4460		1.24	[0.37; 2.12]	0.0%	0.2%
Chien-Hsiung Chen_2009_59	1.2380	0.3450		1.24	[0.56; 1.91]	0.1%	0.2%
Matthew G. Buckley_2018_19	1.2240	0.1970		1.22	[0.84; 1.61]	0.2%	0.3%
Matthew G. Buckley_2018_19	1.2180	0.1960		1.22	[0.83; 1.60]	0.2%	0.3%
Stephanie Irving_2018_20	1.2080	0.3980		1.21	[0.43; 1.99]	0.1%	0.2%
Anthony E Richardson_2011_154	1.1770	0.3420		1.18	[0.51; 1.85]	0.1%	0.2%
Daniel G. Woolley_2010_118	1.1760	0.4620		1.18	[0.27; 2.08]	0.0%	0.2%
Liana Palermo_2008_92	1.1590	0.3830		1.16	[0.41; 1.91]	0.1%	0.2%
Nicole T. Nowak_2015_53	1.1280	0.3080		1.13	[0.52; 1.73]	0.1%	0.2%
Heather Burte_2018_146	1.1260	0.3210		1.13	[0.50; 1.76]	0.1%	0.2%
Chengshun Wang_2018_66	1.1110	0.6800		1.11	[-0.22; 2.44]	0.0%	0.1%
赵梦雅_2019_170	1.1060	0.3800		1.11	[0.36; 1.85]	0.1%	0.2%
Huicong Fang_2020_149	1.0920	0.2080		1.09	[0.68; 1.50]	0.2%	0.3%
刘雨佳_2023_173	1.0840	0.1550		1.08	[0.78; 1.39]	0.4%	0.3%
Edward Slone_2016_47	1.0700	0.5040		1.07	[0.08; 2.06]	0.0%	0.1%
Alexander P. Boone_2019_81	1.0610	0.3780		1.06	[0.32; 1.80]	0.1%	0.2%
Alexander P. Boone_2019_81	1.0530	0.3770		1.05	[0.31; 1.79]	0.1%	0.2%
Valentina Cazzato_2010_61	1.0520	0.3900		1.05	[0.29; 1.82]	0.1%	0.2%
Jennifer T. Sneider_2018_18	1.0460	0.3780		1.05	[0.31; 1.79]	0.1%	0.2%
Jonathan W. Kelly_2009_73	1.0190	0.3760		1.02	[0.28; 1.76]	0.1%	0.2%
Alexander P. Boone_2019_81	1.0030	0.2370		1.00	[0.54; 1.47]	0.2%	0.3%
Yi Pu_2020_69	0.9810	0.3530		0.98	[0.29; 1.67]	0.1%	0.2%
Matthew Ventura_2013_9	0.9800	0.1180		0.98	[0.75; 1.21]	0.6%	0.4%
Paul Newhouse_2007_113	0.9760	0.3350		0.98	[0.32; 1.63]	0.1%	0.2%
Martin Lövdén,_2007_105	0.9730	0.3740		0.97	[0.24; 1.71]	0.1%	0.2%
Alexander P. Boone_2018_131	0.9610	0.2600		0.96	[0.45; 1.47]	0.1%	0.3%
Louisa Dahmani_2011_159	0.9590	0.4230		0.96	[0.13; 1.79]	0.1%	0.2%
Claudia van Dun_2021_137	0.9520	0.2910		0.95	[0.38; 1.52]	0.1%	0.3%
Lucia A. Cherep_2022_85	0.9390	0.1580		0.94	[0.63; 1.25]	0.4%	0.3%
房慧聪2_2012_166	0.9280	0.1920		0.93	[0.55; 1.30]	0.2%	0.3%
Cristina Fernandez-Baizan_2020_134	0.9260	0.3980		0.93	[0.15; 1.71]	0.1%	0.2%
季义双_2021_172	0.9220	0.3040		0.92	[0.33; 1.52]	0.1%	0.2%
Daniele Nardi_2014_161	0.9160	0.3320		0.92	[0.27; 1.57]	0.1%	0.2%
Lorys Castelli_2008_115	0.9150	0.3320		0.92	[0.26; 1.57]	0.1%	0.2%
Alexander P. Boone_2018_131	0.9090	0.2480		0.91	[0.42; 1.40]	0.1%	0.3%
Laura Piccardi_2008_158	0.9080	0.2430		0.91	[0.43; 1.38]	0.2%	0.3%
Lynn S. Liben_2013_46	0.8920	0.3320		0.89	[0.24; 1.54]	0.1%	0.2%
Changxu Wu_2013_94	0.8860	0.4330		0.89	[0.04; 1.73]	0.0%	0.2%
Kyle T. Gagnon_2015_125	0.8680	0.4370		0.87	[0.01; 1.72]	0.0%	0.2%
Antoine Coutrot_2019_157	0.8680	0.4370		0.87	[0.01; 1.72]	0.0%	0.2%
Maddalena Boccia_2017_48	0.8630	0.2850		0.86	[0.30; 1.42]	0.1%	0.3%
Louisa Dahmani_2011_159	0.8590	0.4180		0.86	[0.04; 1.68]	0.1%	0.2%
Kyle T. Gagnon_2018_95	0.8540	0.2140		0.85	[0.43; 1.27]	0.2%	0.3%
Xiang-Zhen Kong_2017_80	0.8450	0.1710		0.84	[0.51; 1.18]	0.3%	0.3%
Margaret R. Tarampi_2016_14	0.8400	0.1800		0.84	[0.49; 1.19]	0.3%	0.3%
Lucia A. Cherep_2022_85	0.8400	0.1560		0.84	[0.53; 1.15]	0.4%	0.3%
Andreas Zwergal_2015_11	0.8390	0.4260		0.84	[0.00; 1.67]	0.0%	0.2%
TiAnni Harris_2019_104	0.8300	0.2330		0.83	[0.37; 1.29]	0.2%	0.3%
Craig Allison_2017_79	0.8250	0.2460		0.82	[0.34; 1.31]	0.1%	0.3%
Steven M. Weisberg_2016_71	0.8240	0.2440		0.82	[0.35; 1.30]	0.2%	0.3%
Martin Lövdén,_2007_105	0.8230	0.3680		0.82	[0.10; 1.54]	0.1%	0.2%
Xiaoqian J. Chai_2009_117	0.8100	0.2270		0.81	[0.37; 1.25]	0.2%	0.3%
Nicole L. Youngson_2019_82	0.8050	0.2320		0.81	[0.35; 1.26]	0.2%	0.3%
Kyle T. Gagnon_2018_95	0.8010	0.2130		0.80	[0.38; 1.22]	0.2%	0.3%
Xiaoqian J. Chai_2009_117	0.8010	0.2270		0.80	[0.36; 1.25]	0.2%	0.3%
Matthew Ventura_2013_9	0.7970	0.1160		0.80	[0.57; 1.02]	0.7%	0.4%
L.E Korthauer_2017_29	0.7910	0.2400		0.79	[0.32; 1.26]	0.2%	0.3%
Jennifer Tropp Sneider_2011_5	0.7900	0.5370		0.79	[-0.26; 1.84]	0.0%	0.1%
Andrea Scheuringer_2017_129	0.7820	0.2080		0.78	[0.37; 1.19]	0.2%	0.3%
S.C. Mueller_2016_144	0.7760	0.3320		0.78	[0.13; 1.43]	0.1%	0.2%
Iveta FajnerovÃ¡_2014_10	0.7730	0.3900		0.77	[0.01; 1.54]	0.1%	0.2%
Lucia A. Cherep_2022_85	0.7690	0.1550		0.77	[0.47; 1.07]	0.4%	0.3%
Jennifer Tropp Sneider_2011_5	0.7650	0.5360		0.77	[-0.29; 1.82]	0.0%	0.1%
Alexander P. Boone_2019_81	0.7640	0.2320		0.76	[0.31; 1.22]	0.2%	0.3%
Alexander P. Boone_2019_81	0.7630	0.3660		0.76	[0.05; 1.48]	0.1%	0.2%
Robby Schoenfeld_2010_42	0.7620	0.2720		0.76	[0.23; 1.30]	0.1%	0.3%
Robby Schoenfeld_2010_120	0.7620	0.2720		0.76	[0.23; 1.30]	0.1%	0.3%
Anthony E. Richardson_2011_75	0.7610	0.3030		0.76	[0.17; 1.35]	0.1%	0.2%
Thomas D. Ferguson_2019_83	0.7600	0.2700		0.76	[0.23; 1.29]	0.1%	0.3%
Alexander P. Boone_2018_131	0.7600	0.2550		0.76	[0.26; 1.26]	0.1%	0.3%
Pierpaolo Sorrentino_2019_148	0.7460	0.3450		0.75	[0.07; 1.42]	0.1%	0.2%
David Rodriguez-Andres_2018_17	0.7400	0.2870		0.74	[0.18; 1.30]	0.1%	0.3%
Steven M. Weisberg_2014_152	0.7400	0.2440		0.74	[0.26; 1.22]	0.2%	0.3%

L. Piccardi_2011_101	0.7390	0.2010	0.74	[0.35; 1.13]	0.2%	0.3%
Jennifer Tropp Sneider_2011_5	0.7320	0.5350	0.73	[-0.32; 1.78]	0.0%	0.1%
Harriet E. S. Rosenthal_2012_64	0.7320	0.2310	0.73	[0.28; 1.18]	0.2%	0.3%
Nicole L. Youngson_2019_82	0.7310	0.2310	0.73	[0.28; 1.18]	0.2%	0.3%
Dustin J. H._2012_34	0.7270	0.3450	0.73	[0.05; 1.40]	0.1%	0.2%
Heather Burte_2018_146	0.7240	0.3080	0.72	[0.12; 1.33]	0.1%	0.2%
Jennifer Burkitt_2007_40	0.7230	0.2310	0.72	[0.27; 1.18]	0.2%	0.3%
Chantal L. Lemieux_2019_68	0.7220	0.2690	0.72	[0.19; 1.25]	0.1%	0.3%
Iveta FajnerovÃ¡_2014_10	0.7150	0.3890	0.71	[-0.05; 1.48]	0.1%	0.2%
Lorys Castelli_2008_115	0.7090	0.3260	0.71	[0.07; 1.35]	0.1%	0.2%
Lynn S. Liben_2013_46	0.7050	0.3260	0.70	[0.07; 1.34]	0.1%	0.2%
Yixuan Zhou_2020_72	0.6990	0.5130	0.70	[-0.31; 1.70]	0.0%	0.1%
Neil Schmitzer-Torbert_2007_100	0.6960	0.2510	0.70	[0.20; 1.19]	0.1%	0.3%
Shuying Yu_2021_23	0.6900	0.2130	0.69	[0.27; 1.11]	0.2%	0.3%
Yi Pu_2020_69	0.6810	0.3430	0.68	[0.01; 1.35]	0.1%	0.2%
C. Fernandez-Baizan_2019_133	0.6790	0.2120	0.68	[0.26; 1.09]	0.2%	0.3%
Summer F Acevedo_2010_3	0.6780	0.2910	0.68	[0.11; 1.25]	0.1%	0.3%
Rul von Stülpnagel_2012_7	0.6770	0.2270	0.68	[0.23; 1.12]	0.2%	0.3%
Danica Hilliard_2019_97	0.6770	0.3000	0.68	[0.09; 1.26]	0.1%	0.2%
Alessia Bocchi_2021_151	0.6750	0.2020	0.68	[0.28; 1.07]	0.2%	0.3%
Ágoston Török_2014_109	0.6730	0.2910	0.67	[0.10; 1.24]	0.1%	0.3%
Kara I. Gabriel_2010_60	0.6720	0.2400	0.67	[0.20; 1.14]	0.2%	0.3%
Luciana Picucci_2011_24	0.6680	0.2150	0.67	[0.25; 1.09]	0.2%	0.3%
Qazi Rahman_2007_114	0.6640	0.1680	0.66	[0.33; 0.99]	0.3%	0.3%
Steven M. Weisberg_2014_155	0.6610	0.2940	0.66	[0.08; 1.24]	0.1%	0.2%
Stefan Münzer_2016_15	0.6600	0.2890	0.66	[0.09; 1.23]	0.1%	0.3%
Anne H. van Hoogmoed_2022_38	0.6600	0.1940	0.66	[0.28; 1.04]	0.2%	0.3%
TiAnni Harris_2019_104	0.6580	0.2300	0.66	[0.21; 1.11]	0.2%	0.3%
Mauro Ceccanti_2018_156	0.6520	0.2530	0.65	[0.16; 1.15]	0.1%	0.3%
Margaret R. Tarampi_2016_14	0.6500	0.1770	0.65	[0.30; 1.00]	0.3%	0.3%
Lucia A. Cherep_2022_85	0.6370	0.1540	0.64	[0.34; 0.94]	0.4%	0.3%
Francisco Munoz-Montoya_2019_93	0.6300	0.3130	0.63	[0.02; 1.24]	0.1%	0.2%
Kyle T. Gagnon_2015_125	0.6290	0.2320	0.63	[0.17; 1.08]	0.2%	0.3%
Belinda Pletzer_2019_25	0.6260	0.2320	0.63	[0.17; 1.08]	0.2%	0.3%
Hai-Ning Liang_2019_50	0.6250	0.4180	0.62	[-0.19; 1.44]	0.1%	0.2%
Irene León_2014_35	0.6230	0.2050	0.62	[0.22; 1.02]	0.2%	0.3%
Craig Hedge_2017_130	0.6210	0.2770	0.62	[0.08; 1.16]	0.1%	0.3%
Luciana Picucci_2011_24	0.6180	0.2150	0.62	[0.20; 1.04]	0.2%	0.3%
Mark P. Holden_2021_52	0.6170	0.2800	0.62	[0.07; 1.17]	0.1%	0.3%
Pierpaolo Sorrentino_2019_148	0.6130	0.3420	0.61	[-0.06; 1.28]	0.1%	0.2%
Liana Palermo_2008_92	0.6120	0.3620	0.61	[-0.10; 1.32]	0.1%	0.2%
Layne Vashro_2015_126	0.6110	0.2400	0.61	[0.14; 1.08]	0.2%	0.3%
Stephanie Irving_2018_20	0.6100	0.3740	0.61	[-0.12; 1.34]	0.1%	0.2%
Emanuele Coluccia_2007_139	0.6060	0.2090	0.61	[0.20; 1.02]	0.2%	0.3%
Emanuele Coluccia_2007_139	0.6060	0.2090	0.61	[0.20; 1.02]	0.2%	0.3%
Michael Tlauka_2008_116	0.6010	0.2530	0.60	[0.11; 1.10]	0.1%	0.3%
Edward C. Merrill_2016_127	0.5980	0.1650	0.60	[0.27; 0.92]	0.3%	0.3%
Alexander P. Boone_2018_131	0.5960	0.2410	0.60	[0.12; 1.07]	0.2%	0.3%
Jennifer T. Sneider_2015_124	0.5920	0.2420	0.59	[0.12; 1.07]	0.2%	0.3%
Raffaella Nori_2015_143	0.5860	0.2280	0.59	[0.14; 1.03]	0.2%	0.3%
Alia L. Yasen_2015_123	0.5810	0.1570	0.58	[0.27; 0.89]	0.4%	0.3%
Michael Tlauka_2008_116	0.5750	0.2520	0.57	[0.08; 1.07]	0.1%	0.3%
Anthony E Richardson_2011_154	0.5720	0.3610	0.57	[-0.14; 1.28]	0.1%	0.2%
Nicole T. Nowak_2010_141	0.5680	0.1750	0.57	[0.23; 0.91]	0.3%	0.3%
应申_2020_171	0.5680	0.3040	0.57	[-0.03; 1.16]	0.1%	0.2%
Nicholas Papemo_2019_21	0.5660	0.2120	0.57	[0.15; 0.98]	0.2%	0.3%
Rosa Cánovas_2011_44	0.5660	0.2280	0.57	[0.12; 1.01]	0.2%	0.3%
Matthew G. Buckley_2018_19	0.5610	0.1840	0.56	[0.20; 0.92]	0.3%	0.3%
David Rodriguez-Andres_2018_17	0.5600	0.2830	0.56	[0.01; 1.11]	0.1%	0.3%
Laura Tascón_2018_162	0.5570	0.1660	0.56	[0.23; 0.88]	0.3%	0.3%
Christoph Hölscher_2009_1	0.5560	0.3600	0.56	[-0.15; 1.26]	0.1%	0.2%
Stefan Münzer_2016_15	0.5520	0.2870	0.55	[-0.01; 1.11]	0.1%	0.3%
Francisco Munoz-Montoya_2019_93	0.5490	0.3110	0.55	[-0.06; 1.16]	0.1%	0.2%
Rul von Stülpnagel_2012_7	0.5480	0.2250	0.55	[0.11; 0.99]	0.2%	0.3%
Changxu Wu_2013_94	0.5470	0.4220	0.55	[-0.28; 1.37]	0.1%	0.2%
Peng Yuan_2014_142	0.5420	0.1820	0.54	[0.19; 0.90]	0.3%	0.3%
Yixuan Zhou_2020_72	0.5410	0.5080	0.54	[-0.45; 1.54]	0.0%	0.1%
Paul Newhouse_2007_113	0.5390	0.3220	0.54	[-0.09; 1.17]	0.1%	0.2%
Chantal L. Lemieux_2019_68	0.5370	0.2650	0.54	[0.02; 1.06]	0.1%	0.3%
Thomas D. Ferguson_2019_83	0.5370	0.2650	0.54	[0.02; 1.06]	0.1%	0.3%
L.E Korthauer_2017_29	0.5340	0.2350	0.53	[0.07; 0.99]	0.2%	0.3%
Ana M. Daugherty_2014_102	0.5310	0.1820	0.53	[0.17; 0.89]	0.3%	0.3%
Jose M. Cimadevilla_2011_6	0.5300	0.2040	0.53	[0.13; 0.93]	0.2%	0.3%
Steven M. Weisberg_2016_71	0.5300	0.2390	0.53	[0.06; 1.00]	0.2%	0.3%
Stefan Münzer_2011_86	0.5260	0.3990	0.53	[-0.26; 1.31]	0.1%	0.2%
Tobias Meilinger_2014_87	0.5230	0.4790	0.52	[-0.42; 1.46]	0.0%	0.2%
Lucia A. Cherep_2022_85	0.5170	0.1520	0.52	[0.22; 0.81]	0.4%	0.3%
Maartje De Goede_2015_88	0.5170	0.2260	0.52	[0.07; 0.96]	0.2%	0.3%
Jennifer T. Sneider_2015_124	0.5170	0.2400	0.52	[0.05; 0.99]	0.2%	0.3%
Jose M. Cimadevilla_2011_6	0.5140	0.2030	0.51	[0.12; 0.91]	0.2%	0.3%
Craig Allison_2017_79	0.5110	0.2250	0.51	[0.07; 0.95]	0.2%	0.3%
Isabelle D. Cherney._2008_91	0.5040	0.1860	0.50	[0.14; 0.87]	0.3%	0.3%

C. Fernandez-Baizan_2019_133	0.5030	0.2100	0.50 [0.09; 0.91]	0.2%	0.3%
C. Zancada-Menendez_2015_12	0.5020	0.3370	0.50 [-0.16; 1.16]	0.1%	0.2%
Alexander P. Boone_2019_81	0.5000	0.2270	0.50 [0.06; 0.94]	0.2%	0.3%
Alexander P. Boone_2018_131	0.4970	0.2500	0.50 [0.01; 0.99]	0.1%	0.3%
Luciana Picucci_2011_24	0.4960	0.2130	0.50 [0.08; 0.91]	0.2%	0.3%
方浩_2019_169	0.4960	0.2270	0.50 [0.05; 0.94]	0.2%	0.3%
Matthew Ventura_2013_9	0.4950	0.1230	0.49 [0.25; 0.74]	0.6%	0.4%
Chengshun Wang_2018_66	0.4930	0.6420	0.49 [-0.77; 1.75]	0.0%	0.1%
Daniele Nardi_2014_161	0.4930	0.3210	0.49 [-0.14; 1.12]	0.1%	0.2%
Tobias Meilinger_2014_87	0.4900	0.4780	0.49 [-0.45; 1.43]	0.0%	0.2%
Mark P. Holden_2021_52	0.4810	0.2780	0.48 [-0.06; 1.03]	0.1%	0.3%
Layne Vashro_2015_126	0.4810	0.1870	0.48 [0.11; 0.85]	0.3%	0.3%
Pierpaolo Sorrentino_2019_148	0.4790	0.3390	0.48 [-0.19; 1.14]	0.1%	0.2%
Isayas Berhe Adhanom_2021_56	0.4770	0.3830	0.48 [-0.27; 1.23]	0.1%	0.2%
Laura Piccardi_2011_121	0.4750	0.2930	0.47 [-0.10; 1.05]	0.1%	0.2%
Steven M. Weisberg_2014_155	0.4750	0.2900	0.47 [-0.09; 1.04]	0.1%	0.3%
Martin Jeli´nek_2014_77	0.4700	0.2530	0.47 [-0.03; 0.97]	0.1%	0.3%
Emanuele Coluccia_2007_139	0.4690	0.2070	0.47 [0.06; 0.87]	0.2%	0.3%
Chengshun Wang_2018_66	0.4610	0.4530	0.46 [-0.43; 1.35]	0.0%	0.2%
Elizabeth R. Chrastil_2015_13	0.4600	0.2070	0.46 [0.05; 0.87]	0.2%	0.3%
Neil Schmitzer-Torbert_2007_100	0.4570	0.2470	0.46 [-0.03; 0.94]	0.1%	0.3%
Peng Yuan_2014_142	0.4560	0.1810	0.46 [0.10; 0.81]	0.3%	0.3%
Chien-Hsiung Chen_2009_59	0.4510	0.3200	0.45 [-0.18; 1.08]	0.1%	0.2%
Andreas Zwergal_2015_11	0.4470	0.4130	0.45 [-0.36; 1.26]	0.1%	0.2%
Ascher K. Munion_2019_67	0.4450	0.1460	0.45 [0.16; 0.73]	0.4%	0.3%
Matthew G. Buckley_2018_19	0.4400	0.1840	0.44 [0.08; 0.80]	0.3%	0.3%
Shuying Yu_2021_23	0.4400	0.2090	0.44 [0.03; 0.85]	0.2%	0.3%
Anthony E Richardson_2011_154	0.4370	0.3580	0.44 [-0.26; 1.14]	0.1%	0.2%
Peng Yuan_2014_142	0.4320	0.1810	0.43 [0.08; 0.79]	0.3%	0.3%
Alessia Bocchi_2018_98	0.4310	0.1990	0.43 [0.04; 0.82]	0.2%	0.3%
V.D. Chamizo_2011_62	0.4300	0.1960	0.43 [0.05; 0.81]	0.2%	0.3%
Alina Nazareth_2018_30	0.4280	0.1970	0.43 [0.04; 0.81]	0.2%	0.3%
Elizabeth R. Chrastil_2015_13	0.4270	0.2060	0.43 [0.02; 0.83]	0.2%	0.3%
Elizabeth R. Chrastil_2015_13	0.4260	0.2060	0.43 [0.02; 0.83]	0.2%	0.3%
Jennifer Tropp Sneider_2011_5	0.4240	0.5230	0.42 [-0.60; 1.45]	0.0%	0.1%
Dustin J. H._2012_34	0.4220	0.3380	0.42 [-0.24; 1.08]	0.1%	0.2%
Laura A. Cushman_2007_140	0.4140	0.1750	0.41 [0.07; 0.76]	0.3%	0.3%
Stefan Münzer_2016_15	0.4130	0.1890	0.41 [0.04; 0.78]	0.3%	0.3%
L. Piccardi_2011_101	0.4120	0.1960	0.41 [0.03; 0.80]	0.2%	0.3%
Chengshun Wang_2018_66	0.4110	0.6390	0.41 [-0.84; 1.66]	0.0%	0.1%
A. Berna_2020_84	0.4110	0.2220	0.41 [-0.02; 0.85]	0.2%	0.3%
Emanuele Coluccia_2007_139	0.4110	0.2060	0.41 [0.01; 0.81]	0.2%	0.3%
Laura A. Cushman_2007_140	0.4060	0.1750	0.41 [0.06; 0.75]	0.3%	0.3%
Xing Huang_2017_145	0.4050	0.2020	0.41 [0.01; 0.80]	0.2%	0.3%
Stefan Münzer_2011_86	0.4000	0.3960	0.40 [-0.38; 1.18]	0.1%	0.2%
Alessia Bocchi_2021_151	0.3990	0.1940	0.40 [0.02; 0.78]	0.2%	0.3%
Jennifer Tropp Sneider_2011_5	0.3980	0.5230	0.40 [-0.63; 1.42]	0.0%	0.1%
Robert S. Astur_2016_70	0.3980	0.1580	0.40 [0.09; 0.71]	0.4%	0.3%
Francesca Foti_2023_33	0.3960	0.2700	0.40 [-0.13; 0.93]	0.1%	0.3%
房慧聪_2012_165	0.3940	0.2060	0.39 [-0.01; 0.80]	0.2%	0.3%
Peng Yuan_2014_142	0.3930	0.1810	0.39 [0.04; 0.75]	0.3%	0.3%
Irene Liu_2011_4	0.3920	0.0820	0.39 [0.23; 0.55]	1.3%	0.4%
Kara I. Gabriel_2010_60	0.3920	0.2350	0.39 [-0.07; 0.85]	0.2%	0.3%
F. Berteau-Pavy_2007_39	0.3870	0.2160	0.39 [-0.04; 0.81]	0.2%	0.3%
Özge Kumo□glu Süzer_2018_147	0.3840	0.2130	0.38 [-0.03; 0.80]	0.2%	0.3%
Isabelle D. Cherney._2008_91	0.3820	0.1850	0.38 [0.02; 0.74]	0.3%	0.3%
Irene Liu_2011_4	0.3770	0.0820	0.38 [0.22; 0.54]	1.3%	0.4%
Maria Brucato_2022_90	0.3620	0.2850	0.36 [-0.20; 0.92]	0.1%	0.3%
Hua Liao_2017_16	0.3580	0.4510	0.36 [-0.53; 1.24]	0.0%	0.2%
Francesca Foti_2023_33	0.3560	0.2700	0.36 [-0.17; 0.89]	0.1%	0.3%
Özge Kumo□glu Süzer_2018_147	0.3550	0.2120	0.35 [-0.06; 0.77]	0.2%	0.3%
Nicole L. Youngson_2019_82	0.3450	0.2250	0.34 [-0.10; 0.79]	0.2%	0.3%
Massimiliano Palmiero_2016_128	0.3450	0.1680	0.34 [0.02; 0.67]	0.3%	0.3%
Véronic Delage_2022_138	0.3420	0.1080	0.34 [0.13; 0.55]	0.8%	0.4%
Sven C. Mueller_2009_74	0.3410	0.2430	0.34 [-0.14; 0.82]	0.2%	0.3%
Francesca Foti_2023_33	0.3380	0.2690	0.34 [-0.19; 0.87]	0.1%	0.3%
Nicole L. Youngson_2019_82	0.3380	0.2250	0.34 [-0.10; 0.78]	0.2%	0.3%
Chin-Teng Lin_2012_63	0.3370	0.3680	0.34 [-0.38; 1.06]	0.1%	0.2%
Alfredo Campos_2020_37	0.3360	0.0860	0.34 [0.17; 0.50]	1.2%	0.4%
Claudia van Dun_2021_137	0.3340	0.2780	0.33 [-0.21; 0.88]	0.1%	0.3%
Ana M. Daugherty_2014_102	0.3300	0.1800	0.33 [-0.02; 0.68]	0.3%	0.3%
Qazi Rahman_2007_114	0.3290	0.1650	0.33 [0.01; 0.65]	0.3%	0.3%
Anne H. van Hoogmoed_2022_38	0.3260	0.1900	0.33 [-0.05; 0.70]	0.2%	0.3%
Edward C. Merrill_2016_127	0.3230	0.1630	0.32 [0.00; 0.64]	0.3%	0.3%
Lorys Castelli_2008_115	0.3180	0.3180	0.32 [-0.31; 0.94]	0.1%	0.2%
Sven C. Mueller_2009_74	0.3140	0.2430	0.31 [-0.16; 0.79]	0.2%	0.3%
Stefan Münzer_2011_86	0.3140	0.3950	0.31 [-0.46; 1.09]	0.1%	0.2%
Claudia van Dun_2021_137	0.3140	0.2780	0.31 [-0.23; 0.86]	0.1%	0.3%
Chien-Hsiung Chen_2020_163	0.3120	0.2690	0.31 [-0.22; 0.84]	0.1%	0.3%
Weihua Dong_2020_22	0.3020	0.3180	0.30 [-0.32; 0.93]	0.1%	0.2%
Steven M. Weisberg_2014_155	0.3010	0.2880	0.30 [-0.26; 0.87]	0.1%	0.3%
Laura Tascón_2018_162	0.2950	0.1640	0.29 [-0.03; 0.62]	0.3%	0.3%

Chengshun Wang_2018_66	0.2850	0.4490	0.28 [-0.60; 1.17]	0.0%	0.2%
Elizabeth R. Chrastil_2015_13	0.2770	0.2050	0.28 [-0.12; 0.68]	0.2%	0.3%
Ineke J. M. van der Ham_2020_106	0.2690	0.0250	0.27 [0.22; 0.32]	14.4%	0.4%
Silvia Erika Kober_2011_122	0.2690	0.3670	0.27 [-0.45; 0.99]	0.1%	0.2%
Paola Verde_2015_65	0.2660	0.2420	0.27 [-0.21; 0.74]	0.2%	0.3%
Wen-Te Chang_2020_150	0.2600	0.2050	0.26 [-0.14; 0.66]	0.2%	0.3%
Irene Liu_2011_4	0.2590	0.0820	0.26 [0.10; 0.42]	1.3%	0.4%
Weihua Dong_2020_22	0.2570	0.3180	0.26 [-0.37; 0.88]	0.1%	0.2%
Irene Liu_2011_4	0.2520	0.0820	0.25 [0.09; 0.41]	1.3%	0.4%
Jennifer Tropp Sneider_2011_5	0.2500	0.5200	0.25 [-0.77; 1.27]	0.0%	0.1%
L. Mandolesi_2009_26	0.2470	0.2120	0.25 [-0.17; 0.66]	0.2%	0.3%
David Rodriguez-Andres_2018_17	0.2370	0.2780	0.24 [-0.31; 0.78]	0.1%	0.3%
Xiaoqian J. Chai_2009_117	0.2270	0.2190	0.23 [-0.20; 0.66]	0.2%	0.3%
Craig Allison_2017_79	0.2190	0.1880	0.22 [-0.15; 0.59]	0.3%	0.3%
Raffaella Nori_2015_78	0.2180	0.2190	0.22 [-0.21; 0.65]	0.2%	0.3%
Craig Allison_2017_79	0.2180	0.2190	0.22 [-0.21; 0.65]	0.2%	0.3%
F. Berteau-Pavy_2007_39	0.2150	0.2150	0.21 [-0.21; 0.64]	0.2%	0.3%
C. Zancada-Menendez_2015_12	0.2140	0.3340	0.21 [-0.44; 0.87]	0.1%	0.2%
Stefan Münzer_2016_15	0.2030	0.2820	0.20 [-0.35; 0.76]	0.1%	0.3%
王芳芳_2017_168	0.2020	0.2530	0.20 [-0.29; 0.70]	0.1%	0.3%
Němá Eva_2020_135	0.2010	0.2810	0.20 [-0.35; 0.75]	0.1%	0.3%
Isayas Berhe Adhanom,_2021_55	0.2000	0.3790	0.20 [-0.54; 0.94]	0.1%	0.2%
InekeJ. M. van derHam_2020_89	0.1910	0.0620	0.19 [0.07; 0.31]	2.3%	0.4%
Francesca C. Fortenbaugh_2007_57	0.1900	0.6340	0.19 [-1.05; 1.43]	0.0%	0.1%
C. Zancada-Menendez_2015_12	0.1860	0.3340	0.19 [-0.47; 0.84]	0.1%	0.2%
Craig Hedge_2017_130	0.1860	0.2710	0.19 [-0.35; 0.72]	0.1%	0.3%
Irene Liu_2011_4	0.1850	0.0810	0.18 [0.03; 0.34]	1.4%	0.4%
Shuying Yu_2021_23	0.1850	0.1930	0.18 [-0.19; 0.56]	0.2%	0.3%
Caspar Goeke_2015_28	0.1840	0.0530	0.18 [0.08; 0.29]	3.2%	0.4%
Isayas Berhe Adhanom_2021_54	0.1830	0.3790	0.18 [-0.56; 0.93]	0.1%	0.2%
Elisângela Vilar_2012_76	0.1820	0.2730	0.18 [-0.35; 0.72]	0.1%	0.3%
Jenhung Wang_2020_164	0.1760	0.0820	0.18 [0.02; 0.34]	1.3%	0.4%
方浩_2019_169	0.1760	0.2240	0.18 [-0.26; 0.62]	0.2%	0.3%
Hai-Ning Liang_2019_50	0.1680	0.4090	0.17 [-0.63; 0.97]	0.1%	0.2%
InekeJ. M. van derHam_2020_89	0.1680	0.0630	0.17 [0.04; 0.29]	2.3%	0.4%
Rosa Cánovas_2011_44	0.1660	0.2240	0.17 [-0.27; 0.61]	0.2%	0.3%
Chien-Hsiung Chen_2020_163	0.1660	0.2680	0.17 [-0.36; 0.69]	0.1%	0.3%
Sven C. Mueller_2009_74	0.1620	0.2420	0.16 [-0.31; 0.64]	0.2%	0.3%
Irene Liu_2011_4	0.1600	0.0810	0.16 [0.00; 0.32]	1.4%	0.4%
Maria Brucato_2022_90	0.1540	0.2890	0.15 [-0.41; 0.72]	0.1%	0.3%
Steven M. Weisberg_2014_152	0.1540	0.2360	0.15 [-0.31; 0.62]	0.2%	0.3%
William J. Tippett_2009_27	0.1500	0.4090	0.15 [-0.65; 0.95]	0.1%	0.2%
Chengshun Wang_2018_66	0.1380	0.4480	0.14 [-0.74; 1.02]	0.0%	0.2%
Jan M. Wiener_2012_108	0.1270	0.3170	0.13 [-0.49; 0.75]	0.1%	0.2%
Nicole L. Youngson_2019_82	0.1250	0.1810	0.12 [-0.23; 0.48]	0.3%	0.3%
Caspar Goeke_2015_28	0.1220	0.0540	0.12 [0.02; 0.23]	3.1%	0.4%
InekeJ. M. van derHam_2020_89	0.1180	0.0620	0.12 [-0.00; 0.24]	2.3%	0.4%
Nicole L. Youngson_2019_82	0.1170	0.1810	0.12 [-0.24; 0.47]	0.3%	0.3%
Chengshun Wang_2018_66	0.1160	0.6330	0.12 [-1.12; 1.36]	0.0%	0.1%
Němá Eva_2020_135	0.1160	0.2800	0.12 [-0.43; 0.66]	0.1%	0.3%
InekeJ. M. van derHam_2020_89	0.1110	0.0630	0.11 [-0.01; 0.23]	2.3%	0.4%
Ramona Schoedel_2018_99	0.1110	0.3290	0.11 [-0.53; 0.76]	0.1%	0.2%
Wenfei Chen_2020_136	0.1110	0.3780	0.11 [-0.63; 0.85]	0.1%	0.2%
Alina Nazareth_2018_30	0.1090	0.1950	0.11 [-0.27; 0.49]	0.2%	0.3%
Francisco Munoz-Montoya_2019_93	0.1090	0.3060	0.11 [-0.49; 0.71]	0.1%	0.2%
InekeJ. M. van derHam_2020_89	0.1080	0.0620	0.11 [-0.01; 0.23]	2.3%	0.4%
Francesca Foti_2023_33	0.1070	0.2680	0.11 [-0.42; 0.63]	0.1%	0.3%
Dominique Piber_2018_132	0.1070	0.2110	0.11 [-0.31; 0.52]	0.2%	0.3%
Paola Verde_2015_65	0.1050	0.2410	0.10 [-0.37; 0.58]	0.2%	0.3%
Elisângela Vilar_2012_76	0.0970	0.2720	0.10 [-0.44; 0.63]	0.1%	0.3%
Maria Brucato_2022_90	0.0960	0.2960	0.10 [-0.48; 0.68]	0.1%	0.2%
Robby Schoenfeld_2010_42	0.0910	0.2630	0.09 [-0.42; 0.61]	0.1%	0.3%
Francesca Foti_2023_33	0.0850	0.2680	0.09 [-0.44; 0.61]	0.1%	0.3%
Martin Jeli´nek_2014_77	0.0850	0.2500	0.09 [-0.40; 0.57]	0.1%	0.3%
Lucia A. Cherep_2022_85	0.0800	0.1500	0.08 [-0.21; 0.37]	0.4%	0.3%
William J. Tippett_2009_27	0.0660	0.4080	0.07 [-0.73; 0.87]	0.1%	0.2%
Jesse Q. Sargent_2018_49	0.0650	0.1390	0.07 [-0.21; 0.34]	0.5%	0.4%
Keri J. Woods_2018_103	0.0640	0.2650	0.06 [-0.46; 0.58]	0.1%	0.3%
Anthony E Richardson_2011_154	0.0620	0.3160	0.06 [-0.56; 0.68]	0.1%	0.2%
Anthony E Richardson_2011_154	0.0620	0.3160	0.06 [-0.56; 0.68]	0.1%	0.2%
F. Berteau-Pavy_2007_39	0.0480	0.2150	0.05 [-0.37; 0.47]	0.2%	0.3%
F. Berteau-Pavy_2007_39	0.0480	0.2150	0.05 [-0.37; 0.47]	0.2%	0.3%
Lucia A. Cherep_2022_85	0.0470	0.1500	0.05 [-0.25; 0.34]	0.4%	0.3%
Alina Nazareth_2018_30	0.0430	0.1950	0.04 [-0.34; 0.43]	0.2%	0.3%
Helen E. Davis_2021_32	0.0430	0.2260	0.04 [-0.40; 0.49]	0.2%	0.3%
Nicole L. Youngson_2019_82	0.0370	0.1810	0.04 [-0.32; 0.39]	0.3%	0.3%
Daniele Nardi_2012_107	0.0340	0.2420	0.03 [-0.44; 0.51]	0.2%	0.3%
Raffaella Nori_2015_78	0.0330	0.2180	0.03 [-0.39; 0.46]	0.2%	0.3%
王芳芳_2017_168	0.0300	0.2520	0.03 [-0.46; 0.52]	0.1%	0.3%
Nicole L. Youngson_2019_82	0.0260	0.1810	0.03 [-0.33; 0.38]	0.3%	0.3%
Raffaella Nori_2015_78	0.0130	0.2180	0.01 [-0.41; 0.44]	0.2%	0.3%
Francesca Foti_2023_33	0.0120	0.2670	0.01 [-0.51; 0.54]	0.1%	0.3%


Sven C. Mueller_2009_74 0.0080 0.2410 0.01 [-0.46; 0.48] 0.2% 0.3%
高雪原_2016_167 0.0070 0.2160 0.01 [-0.42; 0.43] 0.2% 0.3%
Anthony E Richardson_2011_154 0.0060 0.3160 0.01 [-0.61; 0.63] 0.1% 0.2%
Pierpaolo Sorrentino_2019_148 0.0030 0.3340 0.00 [-0.65; 0.66] 0.1% 0.2%
Chengshun Wang_2018_66 0.0000 0.4470 0.00 [-0.88; 0.88] 0.0% 0.2%
Luis Pacheco-Cobos_2010_119 0.0000 0.3090 0.00 [-0.61; 0.61] 0.1% 0.2%
Laura Piccardi_2011_121 -0.0130 0.2890 -0.01 [-0.58; 0.55] 0.1% 0.3%
Alessia Bocchi_2018_98 -0.0200 0.1960 -0.02 [-0.40; 0.36] 0.2% 0.3%
Antonella Lopez_2020_31 -0.0280 0.1540 -0.03 [-0.33; 0.27] 0.4% 0.3%
Robert S. Astur_2016_70 -0.0610 0.1570 -0.06 [-0.37; 0.25] 0.4% 0.3%
Robert S. Astur_2016_70 -0.0770 0.1570 -0.08 [-0.38; 0.23] 0.4% 0.3%
Maria Brucato_2022_90 -0.0830 0.2960 -0.08 [-0.66; 0.50] 0.1% 0.2%
Robert S. Astur_2016_70 -0.0870 0.1570 -0.09 [-0.39; 0.22] 0.4% 0.3%
Alessia Bocchi_2018_98 -0.1300 0.1970 -0.13 [-0.52; 0.26] 0.2% 0.3%
Keri J. Woods_2018_103 -0.1350 0.2650 -0.14 [-0.65; 0.38] 0.1% 0.3%
Robert S. Astur_2016_70 -0.1720 0.1570 -0.17 [-0.48; 0.14] 0.4% 0.3%
Antonella Lopez_2020_31 -0.1730 0.1550 -0.17 [-0.48; 0.13] 0.4% 0.3%
Ramona Schoedel_2018_99 -0.2710 0.3220 -0.27 [-0.90; 0.36] 0.1% 0.2%
Alessia Bocchi_2018_98 -0.2730 0.1970 -0.27 [-0.66; 0.11] 0.2% 0.3%
Luis Pacheco-Cobos_2010_119 -0.3080 0.3100 -0.31 [-0.92; 0.30] 0.1% 0.2%
Qazi Rahman_2005_111 -0.4110 0.2800 -0.41 [-0.96; 0.14] 0.1% 0.3%
Laura Piccardi_2014_36 -0.4160 0.1780 -0.42 [-0.76; -0.07] 0.3% 0.3%
Jean-Charles Chebat_2008_58 -0.4550 0.1630 -0.46 [-0.77; -0.14] 0.3% 0.3%
Alycia M. Hund_2014_160 -0.4720 0.1750 -0.47 [-0.81; -0.13] 0.3% 0.3%
Qazi Rahman_2005_111 -0.4880 0.2810 -0.49 [-1.04; 0.06] 0.1% 0.3%
Joshua New_2007_112 -0.5300 0.2200 -0.53 [-0.96; -0.10] 0.2% 0.3%
Theodora Koulouri_2012_8 -0.5400 0.2740 -0.54 [-1.08; -0.00] 0.1% 0.3%
Jose M. Cimadevilla_2011_6 -0.5460 0.2040 -0.55 [-0.95; -0.15] 0.2% 0.3%
L. Mandolesi_2009_26 -0.5510 0.2150 -0.55 [-0.97; -0.13] 0.2% 0.3%
Xiaoqian J. Chai_2010_43 -0.5990 0.2860 -0.60 [-1.16; -0.04] 0.1% 0.3%
Elisângela Vilar_2012_76 -0.6000 0.2780 -0.60 [-1.14; -0.06] 0.1% 0.3%
Xiaoqian J. Chai_2010_43 -0.6110 0.2870 -0.61 [-1.17; -0.05] 0.1% 0.3%
Nicola Brunswick_2010_153 -0.6470 0.3210 -0.65 [-1.28; -0.02] 0.1% 0.2%
Qazi Rahman_2005_111 -0.6580 0.2850 -0.66 [-1.22; -0.10] 0.1% 0.3%
Denise Head_2010_2 -0.6680 0.3190 -0.67 [-1.29; -0.04] 0.1% 0.2%
赵梦雅_2019_170 -0.7160 0.3650 -0.72 [-1.43; -0.00] 0.1% 0.2%
Hua Liao_2017_16 -0.7250 0.4620 -0.72 [-1.63; 0.18] 0.0% 0.2%
Kim A. Kastens_2007_41 -0.7930 0.3620 -0.79 [-1.50; -0.08] 0.1% 0.2%
Stella F. Lourenco_2011_45 -0.7980 0.3670 -0.80 [-1.52; -0.08] 0.1% 0.2%
Qazi Rahman_2005_111 -0.8150 0.2890 -0.81 [-1.38; -0.25] 0.1% 0.3%
赵梦雅_2019_170 -0.8160 0.3680 -0.82 [-1.54; -0.09] 0.1% 0.2%
L. Mandolesi_2009_26 -0.8390 0.2610 -0.84 [-1.35; -0.33] 0.1% 0.3%
Stella F. Lourenco_2011_45 -0.8570 0.3690 -0.86 [-1.58; -0.13] 0.1% 0.2%
Alycia M. Hund_2014_160 -0.9260 0.1810 -0.93 [-1.28; -0.57] 0.3% 0.3%
Raffaella Nori_2018_96 -1.2440 0.1730 -1.24 [-1.58; -0.90] 0.3% 0.3%
İpek Memikoğlu_2020_51 -1.5640 0.1700 -1.56 [-1.90; -1.23] 0.3% 0.3%
İpek Memikoğlu_2020_51 -1.5750 0.1710 -1.57 [-1.91; -1.24] 0.3% 0.3%
Fixed effect model 0.31 [0.29; 0.32] 100.0% --
Random effects model 0.38 [0.34; 0.43] -- 100.0%
-2 -1 0 1 2
Heterogeneity: I^2 = 75%, τ^2 = 0.1425, p < 0.01